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Fractals, Attractors and the Quantum Self: A New Lexicon for HRM

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ABSTRACT

This conceptual paper investigates how the metaphorical use of concepts from complexity theory may impact the way we think about human resource management theory and practice. The concepts of fractal, strange attractor and quantum self, borrowed from complexity theory are presented. Fractal thinking allows self-similarity through the constants of initial conditions. The magnet-like properties of strange attractors allow self-reference in employees without the danger of going outside of the organization's governing principles. The quantum self portrays the 'both/and' nature of rational and relational thinking. Ideas for placing core values as governing principles at the centre of a human resource model are presented. A design where structures, systems and processes meet the needs of self-referring people is outlined. The model is illustrated by the example of Toyota.

Key words: complexity, fractal, strange attractor, quantum self, human resource management

INTRODUCTION: CHALLENGING FUNCTIONALIST LANGUAGE IN HRM

The objective of this paper is to present an alternative model and language for human resource management (HRM) derived from concepts developed in complexity theory. The need for a new language to think about HRM is predicated by the current state of evolution of theory in the field. Ferris, Hall, Royle, & Martocchio (2004) reviewed the HRM literature since its emergence in the 1910s, and noted that although HRM had evolved away from the early mechanistic assumptions borrowed from Scientific Management, the bulk of HRM theory and concepts still remained rooted in the dominant functionalist paradigm (Burrell & Morgan, 1979; Acedo Gonzalez, Barroso Castro, Casillas Bueno, & Galan Gonzalez, 2001). From early on, this has led to thinking about HRM in terms of functions (Johnson & Lee, 1947). Embedded in HR frameworks are rules and regulations governing many aspects of management. Once institutionalized, they "furnish prescriptions about the right way to manage organizations and to structure internal or extra-organizational relations" (McKinley & Mone, 2003: 361). Thus, much of the language and many of the activities of human resource management are based on assumptions of internal stability of jobs and contexts. Methods designed to fit stability are in evidence (Yeung & Berman, 1997) characterized by: long-term goals, integrated performance, training/development and reward systems, multiple career paths, sophisticated and often statistically supported performance appraisal systems and formal communication systems (Stevenson & Harmeling, 1990; Whiteley, Cheung, & Zhang, 2000). McPhee & Scott-Poole (2001: 505) write: "the majority of research on organizational structures follows a pattern traced in the work of Weber and Taylor. It presents structural properties such as differentiation, centralization and formalization as elements of a bureaucratic or mechanistic style of organizing". A typical HRM system, formed along functionalist, hierarchical, mechanistic

principles is represented in Figure 1. Ferris & al (2004) link the search for order and stability to implicit assumptions of linearity in HRM theory and research, and suggest that further progress may require to break away from this tradition.

The functionalist perspective has been challenged by many authors who argue that its focus on order, stability, and predictability is ill-suited to the conditions of contemporary business activity which call for flexibility and adaptability to respond to turbulence and rapid changes (Brown & Eisenhardt, 1997; D'Aveni, 1994; Stacey, 1996a, Teece, Pisano, & Shuen, 1997). Closer linkages between human resource management and strategy have been recommended (Cappelli & Crocker-Hefter, 1996; Lado & Wilson, 1994; Wright & Boswell, 2002) and particularly strategies for change (Clegg, 2003). A renewal of HR thinking, principles and practices has been advocated (Gregersen & Sailer, 1993; Mathews, White, & Long, 1999). Arguably, such a renewal requires new theoretical models (Ferris et al., 2004) and also a new language. The language of functionalist HRM, with its roots in military and command-and-control semantics, has, according to post-modern writers on organizational studies, become a grand or meta language (Cooper & Burrell, 1988). What this means in practice is that, whether we recognize it or not, when we are using the language of functionalist HRM we are validating the modernist, mechanistic ideology that underpinned the early days of industrial organization (Chia, 1997; Rhodes & Garrick, 2003). In other words, because the way in which we talk about the world contributes to shaping our reality (Rorty, 1991) introducing a new lexicon allows to talk about and see the world anew (Astley, 1985). In order to propose a renewed framework for HRM, a new language, freed from the underlying assumptions of the functionalist meta language, is necessary.

One way to generate a new language is to resort to metaphors (Ortony, 1975; Lackoff & Johnson, 1980; Morgan, 1996). By transferring -and thus transforming- concepts from one domain to another (Cornelissen, 2005) metaphors help generate new meaning and insights (Oswick, Keenoy, & Grant, 2002). Some authors have argued that the complexity of organizational phenomena does not lend itself easily to quantitative analysis and that qualitative, narrative approaches are better suited (Langley, 1999; Pentland, 1999; Tsoukas & Hatch, 2001), and metaphors fit well within a narrative context (Watson, 1995). The language of complexity theory is remarkably apposite for the purpose of renewing HRM theories and models: the lexicon of complexity theory is located outside of organizational and management terminology; complexity theory concepts are explicitly designed to deal with non-linear relationships, turbulence and change; and finally complexity theory contains powerful notions that can be leveraged as new metaphors for HRM theory and practice. Fractals, strange attractors, and quantum are the three concepts around which we build a renewed conceptual model for HRM.

We start by reviewing briefly the literature linking management research and complexity theory. In the second section we introduce the concepts of fractals, strange attractors and quantum self as metaphors from complexity theory. In the third section we outline what a complexity HRM system based on these concepts could look like. We conclude with a discussion of implications for practice and research.

COMPLEXITY SCIENCE AND MANAGEMENT RESEARCH

"Complexity science", within which chaos and quantum thinking reside, is a generic term that designates contemporary advances in the natural sciences (biology, chemistry, mathematics, meteorology, physics, ...) relating to chaos, complex adaptive systems,

dissipative systems, non-linear dynamic systems, quantum physics and associated theories (Marshall, Zohar, & Peat, 1997). Complexity theories contrast the traditional, orderly, linear thinking of Newtonian science with that of chaotic, non-linear thinking (Freedman, 1992). Complexity theories contradict Newtonian science in several ways:

- relationships between cause and effect are not always predictable: small changes in inputs can generate disproportionate changes in output (Lorenz, 1963);
- patterns of underlying order may be found in and/or emerge from the apparently chaotic or random behavior of complex systems (Mandelbrot, 1977; Prigogine & Stengers, 1983; Prigogine, 1996);
- to identify patterns of order in complex systems, it is more useful to focus on the dynamics of the overall system, rather than the behavior of its parts (Gell-Mann, 1994; Holland, 1995; Kauffman, 2000).

The notion that organizations are complex is not new (Perrow, 1972; Thompson, 1967) but it is only in recent years that theories of complex systems have been applied in organization science and management research (Anderson, 1999; Tsoukas & Hatch, 2001; Shaw, 2002). The application of complexity theory in management and organizational research faces several obstacles at the methodological (Johnson & Burton, 1994), theoretical (Ortegon-Monroy, 2003), and ontological levels (Loye & Eisler, 1987; Thiétart & Forgues, 1995). To date, complexity theory concepts have been predominantly used in a qualitative and metaphoric sense in organizational research, especially regarding turbulence and change (Morgan, 1996; Mathews et al., 1999; Stacey, 1996a). Although diverse applications abound, three domains have attracted the greatest attention:

- General implications for organizational research and design have been examined (Anderson, 1999; Farazmand, 2003; Freedman, 1992; Kay, 2001; Rowland, 2004; Svyantek & Brown, 2000; Thiétart & Forgues, 1995).
- Management of change has arguably been the most popular topic thus far, as chaos and complexity theories provide the background to explore turbulent environments (Brown & Eisenhardt, 1997) and view change as a continuous process, rather than a discrete event (e.g. Dolan & Garcia, 2002; Fitzgerald & van Eijnatten, 2002; Lillrank, 2002; Macintosh & Maclean, 1999; Morgan, 1996; Palmer & Dunford, 2002; Shaw, 2002; Stacey, 1995; Styhre, 2002; Thiétart & Forgues, 1997; van Eijnatten & van Galen, 2002).
- Finally, the metaphors of chaos and complexity have been applied to strategic management theory (e.g. Brown & Eisenhardt, 1998; Eisenhardt & Sull, 2001; Lane & Maxfield, 1996; Merry, 1999; Sanchez, 1997; Spender, 1998; Stacey, 1993).

Many of these works are (at least in part) relevant to human resource management theory and practice. To this day, however, few authors have specifically examined the implications of complexity theory concepts for the HR discipline, and research such as Mendenhall, Macomber, Gregersen & Cutright (1998) remains scarce. This is somewhat paradoxical, because concepts from complexity theory evoke some of the ever-present problems of human relations in the workplace which are not well accounted for in the functionalist literature. For example, the notion that small disturbances may have disproportionate consequences elsewhere in the organization is not often engaged with; traditional HRM theory and practice would usually favor discouraging behavior that is perceived as "chaotic" rather than looking for patterns of underlying order; and the functionalist perspective tends to view the organization as a sum of organizational and HR functional parts rather than as a

whole. Metaphors borrowed from complexity theory can enable us to part with this tradition and refresh our thinking about HR models. In the next section we discuss the three metaphors of fractals, attractors, and the quantum self, which form the cornerstones around which we build a blueprint for a renewed framework for HRM.

FRACTALS, ATTRACTORS, AND QUANTUM

Fractals

Mandelbrot (1977) describes fractals as patterns inside of patterns: self-similar structures, able to produce detail at finer and finer scales, but governed by constant parameters whatever the scale. Initial conditions influence the pattern from which iteration emerges at any scale or level and in a self-similar way. Briggs & Peat (1989: 75) describe the mirror effect that is gained when any fractal part is examined: "the whole shape of things depends upon the minutest part. The part is the whole in this respect for through the action of any part, the whole in the form of chaos or transformative change may be manifest".

It has become traditional to look for sameness and order within the structures, systems and processes that are central to the human resource management function (Johnsson, 1993). In many organizations, conscious attempts are made to isolate and differentiate groupings of people. Such distinctions may be drawn according to job hierarchies and divisions, status, some shared relationship with clients, or other criteria. Changes within these groupings are often quarantined from the whole in terms of organizational thinking: each part is managed as if it were independent from the others. Managing organizations in this way can lead to fragment the sense of wholeness, leading organizations to engage in paradoxical behaviors (Frost, Moore, Reis, Lundberg, & Martin, 1991; Tsoukas & Hatch, 2001). What appears at first to be a rational response to the complexity of modern organizations leads to

unexpected consequences (Perrow, 1984) and breakdowns in sense-making (Weick & Roberts, 1993). The concept of fractal relationships suggests that even a minute change in the ‘information’ that constitutes the part may have a scaled up impact on the whole: thinking of the parts independently of each other -and of the whole- in this perspective appears to be misguided, and may be dangerous.

The principle of "requisite complexity" (Nohria & Ghoshal, 1994) states that the complexity of the organization should match that of its environment. In today's business context, this often leads to a multiplication of regulations, policies and procedures. However, the impact of multiple operational procedures and regulations on organizational performance is difficult to ascertain (Ferris et al., 1998) and the multiplication of procedures is sometimes counter-productive, especially when policy generation is self-accelerating (Cropanzano & Byrne, 2001). When faced with such a bewildering array of rules, it is understandable that employees might find it difficult to recognize what senior managers consider to be of vital importance. Which ones, they may ask, are the key defining priorities that tell us who the organization is and what it stands for?

The fractal concept suggests that compliance need not be organized around a proliferation of rules brought about to match the complexity of the work environment, on the contrary. In the realm of organizations, fractal self-similarity leads to view uniqueness or individual expression as governed by and developed through some binding agent such as a set of very meaningful basic, generic, rules (Eisenhardt & Sull, 2001; Spender, 1998). In this view, individuals, groups, departments, sites, and/or foreign locations share the same organizational rules as a whole entity. Thus the fractal view suggests that organizing according to a small number of simple and shared rules provides a mechanism to cope with complexity, and at the same time preserve the identity of the parts and of the whole

simultaneously. Using simple rules allows the expression of fractal self-similarity at all levels of the organization (and at all levels of aggregation). One of the challenges of this approach is then to maintain the variations generated by individual actions within the rules' boundaries, in other words how to maintain order within apparent chaos. This is a property of strange attractors.

Strange Attractors

"The systems which generate [the strange attractors] jump around, they show no predictable pattern to their behavior. They are chaotic. [...] The attractor these systems cling to is a kind of organized disorganization of phase space -which is why scientists call it 'strange' " (Briggs & Peat, 1989: 45). Turbulence is often used to describe a possible future for business and society (Loye & Eisler, 1987; Clegg, 2003). For managers who try to predict and plan for the future, this can be unsettling because management systems are traditionally predicated on order and stability (Freedman, 1992, Ehrlich, 1997). Turbulence and chaotic systems imply that organizations cannot be precisely controlled, for the future cannot be predicted beyond short time horizons (Lane & Maxfield, 1996). Faced with this contradiction managers may experience cognitive dissonance (Feistinger, 1957) and attempt to impose excessive order, rather than engage in managing the inevitable chaos (Quinn, 1985). In doing so, they may rigidify their organizations, diminishing flexibility and ability to change, leading to situations where chaos is generated out of order (Thiétart & Forgues, 1995). The other extreme occurs when "managers go too far and demonize structure as the anathema that stifles freedom, flexibility and innovation" (Brown & Eisenhardt, 1998: 34) leading the organization to fall into a "chaos trap", where the lack of organizing rules leads to inconsistent and erratic results.

The metaphor of the strange attractor suggests that a special kind of order can be brought to bear within turbulence. What could exert such a pull in organizational life? Something so important and valent to members of an organization that it would generate a bounded space, within which individuality could be expressed and yet be governed by some universal 'formula'. Many authors have suggested that such a result can be attained when managers clearly define a consistent set of core values for their organizations (Bolman & Deal, 1997; Collins & Porras, 1995; Dolan & Garcia, 2002). Core values determine how organizational members perceive their environment and act (Weick, 1995). Core values are like strange attractors for organizations in the sense that when they have been internalized by organizational members, people are at the same time externally regulated by the core values and self-regulating (Ouchi, 1980).

A related concept from complexity of relevance to our discussion is that of self-reference. Transposed in the context of organization, self-reference means that individuals or groups working within given parameters, such as core values, will use their own styles, judgment and creativity to organize themselves. This rejoins Weick's (1995) suggestion that nowadays, efficient firms are organized around small, semi-autonomous and self-organizing teams, whose behavior is governed by a shared set of underlying premises. However, self-referencing is not a widespread practice: in contemporary organizations, other-referencing and rule-referencing dominate. Other-referencing is a function of hierarchies and of referring to 'higher ups' across almost every aspect of work activity. Rule-referencing, as the term suggests, implies turning to some written rule, regulation or instruction to inform 'correct' behavior (Argyris, 2004). Dolan, Garcia, & Auerbach (2003) contrast in this way "management by instructions" (other-referencing) and "management by objectives" (rule-referencing) with "management by values" (self-referencing). Self-referencing suggests a

concept of humans in organizations that is quite different from that implied by other-referencing and rule-referencing. Self-referencing implies autonomous and reflexive action, engaging the whole person, both rationally and emotionally (Markoczy & Goldberg, 1998). By contrast, in other- and rule-referencing, self-reflexivity is not required because the individual's actions are either evaluated by others, or have to conform to rules, so the rational and logical dimension dominates. The notion that self-referencing beckons both our rational and emotional selves echoes the concept of the "quantum, self", our third metaphor.

Quantum Self

Quantum physics deals with the behavior of small particles, at a scale where the traditional laws of physics break down. Quantum physicists often refer to the classical physics' preoccupation with *either/or* thinking: things are either A or B, X or Y. The study of light using quantum physics shows that such a dichotomous way of thinking is not helpful because light is composed of *both* waves and particles, and therefore *both/and* thinking is required. Waves are very different in character from particles and yet both exist in the quantum reality. Waves contain many possibilities, all equally real, all happening at once, some mutually contradictory and others in harmony. Particles tell a different story: they are solid, separate and self contained, they occupy a discrete place in space and time. They are part of one reality and if they do meet, they instantly separate and go their own way. "In quantum physics, both the nature of being as a dynamic wave-particle dualism and the notion of transformation as a process through which things like electrons and photons are spread out all over space and time carry enormous implications for the kinds of relationships found between quantum systems [...]. While solid, Newtonian particles that meet must clash and go their own ways, wave fronts that come together tend to overlap and combine [...] when two quantum systems meet, their particle aspects tend to stay somewhat

separate and to maintain shades of their original identity, while their wave aspects merge, giving rise to an entirely new system that enfolds the originals" (Zohar & Marshall, 1994:31).

Thinking of human beings in quantum terms gives rise to the metaphor of the quantum self. Zohar (1990) argues that since the time of Newton, humans beings have been considered as part of a clockwork universe. We have been subjected to a mechanistic outlook that has defined people as particles and stopped us from keeping in touch with a valuable part of our nature. The metaphor of the quantum self leads to view people as both wave and particle, expressing the duality present in human nature. In the realm of organizations, rationality is often contrasted with emotion and creativity. Many of the assumptions that underlie the design of management structures systems and processes appear to be predicated on the particle, rational, view of people (Weisbord, 1987). Often a 'reality' is presented through a policy or procedure and the individual is expected to enact it and not confuse it with other realities in the system. However, human beings are forever reinventing themselves through their imaginative capabilities (Hayles, 1991), yet at the same time are conscious of an enduring sense of personal identity (Varela, Thompson, & Rosch, 1993). Harnessing people's creative abilities requires *both/and* thinking about management structures and systems: because creative thinking processes do not unfold linearly (Cheng & van de Ven, 1996), where rational thinking intervenes in creativity cannot be predicted *ex-ante*.

The metaphor of the quantum self suggests that organizations may benefit from releasing and realizing the quantum capacities of people. What is required of human resource managers who would want to achieve this is to free persons and groups from a solely "particle" existence. This implies empowering people (Forrester, 2000) in a negotiated context that allows for the emergence of creativity and innovation (Nonaka & Konno,

1998). Organizations that create such contexts incorporate a "freedom to become" within the "responsibility to conform" (Shelton & Darling, 2001), and thus reflect quantum characteristics.

In the next section, we bring together the three metaphors of fractals, strange attractors and quantum self into a renewed model of HRM, based on and designed to accommodate complexity.

TOWARDS A COMPLEXITY MODEL OF HRM

Our discussion of the complexity metaphors led to three inter-connected elements as a basis for a renewed HRM model:

- thinking of organizations as having fractal properties -self-similarity at different scales- led to suggest that a small number of simple rules may be more effective than an ever-expanding number of policies and procedures when coping with the complexity of contemporary business environments;
- conceiving of core values as the organizational equivalent of strange attractors provides for a mechanism to enable organizational members to operate as self-referencing actors;
- the metaphor of the quantum self suggests that empowering teams within the appropriate context enables employees to be both rational and creative.

The complexity model (Figure 2) thus created implies a very different concept of HRM compared to the functionalist tradition (cf. Figure 1 above): instead of a pyramid made of single linear, hierarchical, relationships, the model is a diamond-shaped network involving multiple relationships. A second difference is that the complexity model, unlike functionalist theory, does not attempt to specify systems, structures and procedures ex-ante.

Instead, by focusing on the factors that lie upstream of systems, structures and procedures (rules, values, empowered teams) the complexity model helps to specify the parameters within which these elements will be created. In that sense the model is self-consistent: if we advocate that empowered employees generate their own systems, then we cannot define what these will be *ex-ante*, we can only determine the boundaries within which they will operate. In the following paragraphs, we discuss the elements of the model and their relationships.

Insert Figure 2 about here

Core values

Core values (Schein, 1991) sit at the apex of our diamond. Organizational values define the identity of the organization (Albert & Whetten, 1985), and provide the foundation for the development of its strategic mission (Campbell & Tawadey, 1993). Therefore core values are of the utmost importance to the top management team (Collins & Porras, 1994). HR managers may be involved in shaping and selecting organizational values, but they also play a key role in institutionalizing them within the organization. Recruitment policies, induction and training programs, incentive schemes, all should reflect and convey the salience of organizational values. Otherwise, the gap between espoused theories and theories in use (Argyris & Schon, 1974) may be so great that people will only pay lip service to values, and organizational coherence may collapse.

As the organizational equivalent of strange attractors, values bound the behaviors of organizational members. This is where values and simple rules meet: both values and rules direct the behavior of organizational members, but in different ways. Rules provide

procedures for decision making ("if x, then y"), whilst values are statements of what's important to the organization (for example: "customer satisfaction", "employee safety"). Rules are usually explicit, whilst values are often implicit: values are often bestowed informally by organizational founders (Collins & Porras, 1994) and become taken-for-granted by employees who have internalized them (Weick, 1995). It is this tacit character that gives values their salience for they are an invisible form of control (Perrow, 1977). Values and rules must form a consistent set. Otherwise, values may not perform as the bounding force that enables organizational members to stay within the tolerance limits of the rules, and behavior may become chaotic and erratic. For example if an organization works according to the rule that customer orders must always be fulfilled on time, this may well clash with values of say, employee safety, or product/service quality.

Simple rules

Simple rules are the expression of the strategy of the organization (Spender, 1998). A clear statement of a small number of simple rules -Eisenhardt & Sull (2001) suggest that about half a dozen rules is sufficient- provides strong direction for the organization and enables to see beyond the proliferation of rules and regulations imposed on organizations by outside agencies such as the International Standards Office (Watkins & Gutzwiller, 1999), governments and/or regulators. These external factors imply that some rule inflation may be unavoidable. But a clear differentiation between those rules that are strategic and those that are not provides a sense of perspective: when they know which rules are strategic, people can then interpret non-strategic rules in the light of the former. This is where rules meet values: because no rule can ever be complete, there is always room for interpretation (Crozier, 1980; Tsoukas, 1996), and the role of values is to bound the interpretation of the rules by organizational members.

The existence of degrees of freedom in the interpretation of rules (even if bounded by values) opens up the possibility that more than one path can be traveled towards the achievement of organizational goals, in other words "equifinality" (Gresov & Drazin, 1997) characterizes organizational action. There is no "one best way" to achieve goals, otherwise all organizations would be identical (Nelson, 1991) and if it were possible to follow one "rule to riches" (Barney, 2001) then there would no room left for creativity in the organizational realm.

At the same time, simple rules can also be considered the "initial conditions" of the organization as a complex system: depending on their salience and consistency, rules can tip organizations into order, or chaos (Thiétart & Forgues, 1995). Following the principle that theory does not precede action, but proceeds from successful accomplishments (Rorty, 1991; Ryle, 1949), the rule set may not be given from the beginning, but rather proceed from and evolve with the experience of the organization. Organizational members may be requested to follow rules, but because they are also responsible for effective action, their experience is an invaluable source of information for the evolution of the rules. This is a justification for organizing around empowered teams.

Empowered teams

The complexity and scale of contemporary organizations implies that teams, rather than individuals, are the appropriate level of analysis (Grant, 1996): teams enable people to overcome the bounds of individual rationality (March & Simon, 1958) and achieve the benefits of division of labor (Weick, 1979). The metaphor of the quantum self indicated that self-referring people are potentially more capable of drawing simultaneously from rationality and creativity. But affording some degree of freedom in action is not

synonymous with allowing people to be idiosyncratic to the point where organizational objectives are not met, due to breakdowns in coordination and/or cooperation (Grant, 1996). Empowered teams draw on both rational and creative selves of employees. But the creativity is not unfolding at random: it is guided by the rules and bounded by values. Thus the outcome of creative efforts is upwards (improvement on existing), rather than downwards (reinventing the wheel), or sideways (unrelated to the business) (Vaghefi, Woods, & Huellmantel, 2000). To ensure that creativity is properly directed, organizational members need to be given supporting guidance, and induction and training programs play a key role in this respect (Suzuki, 2004). But formal programs are not always sufficient and need to be supplemented by values-binding devices such as rituals, ceremonies, and the symbols of language and metaphors (Deal & Kennedy, 1982). It is an integral part of the role of HR managers as culture and change agents to support these, for they enable the rules to be lived, appreciated and thickened. When managers trust that people can support and generate robust rules and value systems, then organizations can benefit from participatory rather than authoritarian problem-solving and decision-making (Ashmos, Duchon, McDaniel, & Huonker, 2002), bridging the gap between "thinkers" and "doers" (Loye & Eisler, 1987). Self-reference thus fosters autonomy and empowerment in a pragmatic sense: with guidance, self-referring people can take care discriminately of their own methods of monitoring and reporting their performance (Forrester, 2000).

Structures, Systems and Processes

In the complexity model outlined in Figure 2, Structures, Systems and Processes are not the outcome of a hierarchical process cascading down the organization from the strategic apex, but the outcome of multiple interactions involving rules, values and empowered teams. Systems articulated around simple, generic rules would allow self-similarity to occur but

would also support self-referring individuals and self-organizing teams through standardized policies and procedures where necessary. For example, within the self referring framework there is a need for technical support and standards such as those afforded through various quality and legal frameworks. There would be a need for advice, support, and training concerning tasks, particularly where new technologies and technical challenges come into play. Information systems ensuring that timely information enhances the task at hand would be required, requiring wide-ranging access by virtually all employees (Nonaka & Takeuchi, 1995). There needs to be order within the chaos of the quantum self. Order in chaos for the human resource manager means supplying orderly structures and systems at the same time as dismantling those control systems that interfere with self-reference and generic rules. Traditionally, human resource managers have been skilled in catering to the particle aspects of people and opportunities for separateness and part-ness characterize many of our designs. To allow for empowerment and self-organization to take place, HR managers would need to switch from a role where they prescribe structure and systems to one where they validate emergent organizational innovation, and accommodate variations within the bounds of the attractor space defined by the core set of rules and values.

This suggests that HRM systems exhibiting high robustness and adaptability would consist of a loosely coupled (Weick, 1976) and reduced set of policies, procedures and controls, reflecting core values. This contrasts strongly with the functionalist design of a rigidly-coupled system consisting of ever-expanding sets of policies, procedures and controls, aiming to cover constantly evolving and unpredictable contingencies. In the traditional model of HR organization, structure, systems and processes are at the centre of things. They are sometimes so powerful that compliance becomes the most desirable trait for managers

and employees alike. Often rules and regulations and other institutionalized processes become a surrogate set of core values and initial conditions. The complexity model affirms the priority of core values over systems, policies and procedures. They do not exist for people to conform, but to support organizational members. This support may well entail a degree of compliance, but only within bounds defined by core values. The human resource management challenge becomes that of balancing regulatory needs with those required for creativity and innovation.

ILLUSTRATION: HRM AND THE TOYOTA PRODUCTION SYSTEM

The main feature of operations and manufacturing management at Toyota have been widely described under the heading of the "Toyota Production System" (TPS) (Spear & Bowen, 1999**,** Womack & Jones, 1996). Despite attempts by Western manufacturers to imitate TPS, most are still lagging behind Toyota's performance (Fane, Vaghefi, Van Deusen, & Woods, 2003). A major cause of the imitators' underperformance has been attributed to their failure to implement the HRM model associated to TPS (Fane et al., 2003). In this section, we draw from the few English-language descriptions of the TPS-related HRM systems (Vaghefi et al., 2000; Suzuki, 2004) and discuss how they illustrate our complexity model.

Core Values

The TPS is driven by three core values: aversion for waste, concern for manufacturing flow, and respect for people (Taylor & Kahn, 1997). Aversion for waste is captured by the Japanese concept of *muda* (Womack & Jones, 1996). *Muda* is about reducing unnecessary work, redundancies, inventories, that add no value to customers. This led Toyota to implement a production system driven by customer orders, where manufacturing and assembly are effected "Just In Time" (Vaghefi et al., 2000). The concern for manufacturing

flow is captured by the Japanese concept of *jidoka*. Suzuki (2004: 210-211) discusses the evolution of *jidoka* from referring to mechanical autonomy at the level of one workstation (automatic manufacturing and shut-off) to embracing the smooth operation of a whole assembly line, the rapid detection of problems, the analysis of their causes and the creation of a solution. Respect for people, a loose translation of *genba shugi* -literally "shopfloor focus" (Suzuki, 2004: 213)- is the third core value, and implies that employees will be productive and motivated if they are empowered and given appropriate training and support (Vaghefi et al., 2000).

The HR system that supports TPS is driven by these three core values, declined over the years into a model incorporating simple rules and empowered teams, supported by systems, policies and procedures (see Figure 3)

Insert Figure 3 about here

Simple Rules

The Toyota Production system has not been explicitly formulated in terms of simple rules, but it has been described as "not especially complicated" in conceptual terms (Vaghefi et al., 2000: 63) and so it appears amenable to a simple rules formulation. Our discussion does not pretend to be exhaustive, and will focus on key HR-related rules. The first simple HR rule can be formulated as: "all workers should think of themselves in certain respects as managers" (Vaghefi et al., 2000: 64). This rule implies that employees should be given responsibilities for their work and their performance, so assembly line workers are responsible for the basic maintenance of their workstation, the quality of production, and have the responsibility to interrupt manufacturing if they detect a defect (Suzuki, 2004:

205). The second rule is that all workers should be multi-skilled. The ability to switch between production tasks is critical to the smooth operation of JIT manufacturing so workers must be able to rotate between jobs (Vaghefi et al., 2000). A third rule is that all workers contribute to continuous improvement and problem-solving. This rule is underpinned by the desire to fully utilize the potential of the manpower, not just their hands, but also their brains (Suzuki, 2004; Vaghefi et al., 2000). In other words, Toyota employees are called to utilize both their quantum selves.

Empowered Teams

The organization of manufacturing work around teams is essential to support flexible manufacturing: if production runs are small and assembly lines accommodate a variety of models, then work configurations change frequently. Centralized control of these changes would be costly, compared with self-management by teams of multi-skilled workers, who collectively can adapt to the changes. Teams are the basic unit for problem-solving, continuous improvement, and safety (Vaghefi et al., 2000). Finally, teams are also the basic unit for performance measurement and reporting: if workers rotate between jobs, but teams handle whole work modules, then it is difficult to separate out individual from team performance (Suzuki, 2004). The organization of production between teams responsible for modules assembly exhibits loose-coupling: work *within* teams is tightly coupled, but within scale parameters that make tight couplings manageable, whilst work *between* teams is loosely coupled, enabling flexibility at the level of the assembly line as a whole. The flat, team-oriented structure of Toyota's assembly plants is reflected in that there are only two job descriptions for an entire plant: assembly line worker, and craft technician (Vaghefi et al., 2000). Fane et al. (2003: 55) comment: "this managerial philosophy, where

empowerment begins at the shop floor, is in contrast to the one we have been used to: top-down management systems".

Structure, Systems and Processes

The TPS-related HR model is supported by the following main processes, systems and structures:

- ***Recruitment***: employees are screened primarily for their attitude and learning potential. The willingness to contribute to the TPS is more important than the skills already acquired (Vaghefi et al., 2000). Toyota believes it can train workers to acquire manufacturing-related skills, but that willingness to contribute and learn can't easily be taught.
- ***Induction***: empowered employees are expected to behave in some respects like managers, so the induction programs are giving broad ranging exposure to TPS, Toyota's strategy and operations. In addition, all assembly workers are explained all the jobs in the assembly line, so they understand where their individual contribution fits in the overall picture.
- ***Safety training***: Toyota believes that employee morale and motivation are underpinned by safety in the workplace. All employees are given extensive safety training, and each plant features a safety "war room" (Vaghefi et al., 2000: 65) where accidents and remedial solutions are documented.
- ***Skills training***: multi-tasking and job rotations are enabled by extensive training programs, where employees learn how to use tools, and how to perform basic maintenance (Vaghefi et al., 2000).
- ***Employee empowerment***: all employees are responsible for quality and are empowered to stop the whole assembly line (if need be) when they spot quality

defects. This is done by pulling the so-called "andon" cord (Taylor & Kahn, 1997).Beyond, this symbolic device, employees are also incentivised to participate in identifying the causes of defects and proposing solutions (Suzuki, 2004). Thus HR practices at Toyota aim to bridge the gap between "knowers" and "doers".

- ***Creativity and problem solving***: employees are trained in analytical and problem solving techniques, and are provided with the resources necessary to implement the solution they propose (Vaghefi et al., 2000).

The example of the TPS-related HR practices at Toyota illustrate that HR systems can be organized according to our complexity model. It also indicates that such approaches may be difficult to implement because they entail a departure from traditional practices. This is illustrated by the following comments from a senior Toyota manager at a US transplant: "Many plants have put in an andon cord that you pull to stop the assembly line if there is a problem. A 5-year old can pull the cord. But it takes a lot of effort to drive the right philosophies down to the plant floor. A lot of people didn't want to give the needed authority to the people on the line who deserve it" (Taylor & Kahn, 1997: 100). The need to construct a new vision of the world thus requires to build a new language.

CONCLUSION

Linear approaches have served organizations well in the past, but appear increasingly ill-suited to the turbulent conditions of the contemporary business environment (Mendenhall et al., 1998). The metaphors from complexity, chaos and quantum open up a new path for human resource managers, away from the linear approach, and make way for a new vision, that of a world within a world, where order emerges out of chaos, and regularities within turbulence. Stacey (1996b) presented adaptive feedback systems as networks where the

behavior of agents is determined by shared schemas consisting of a few basic rules which apply to all. Under certain initial conditions, core values can act as magnets to pull individual expressions of behavior into place (Briggs & Peat, 1989; Wheatley, 1992; Zohar & Marshall, 1994). Such a view is not entirely new: in the past, writers such as Perrow (1977) had expressed similar ideas in a slightly different form. The contribution of the metaphors from complexity and chaos is to allow us to update our thinking so that we can make sense of our times contemporaneously (Colville, Waterman, & Weick, 1999).

We have outlined the foundations of an HR system designed to meet turbulent environments: articulated around core values, it integrates flexible and evolutionary structures and systems, enables -within bounds- self-referring behavior, and supports information feedback loops. This suggests a richer, more complex role for human resource managers, and also perhaps a slightly less comfortable position in that they may have to accommodate greater variation and turbulence. It follows that the future of human resource management may entail a shift away from the prescription of roles, structures, systems and controls, towards the support of empowered, self-referring people and self-managing teams, and the validation of emergent and self-organizing systems.

Our aim in introducing the metaphors of complexity into the language of human resource management is to stimulate the debate and dialogue about the future of research and practice in the discipline. These metaphors are valuable because they afford a break away from traditional representations and thus open up new possibilities.

FIGURES

Figure 1: Traditional Functionalist HRM System

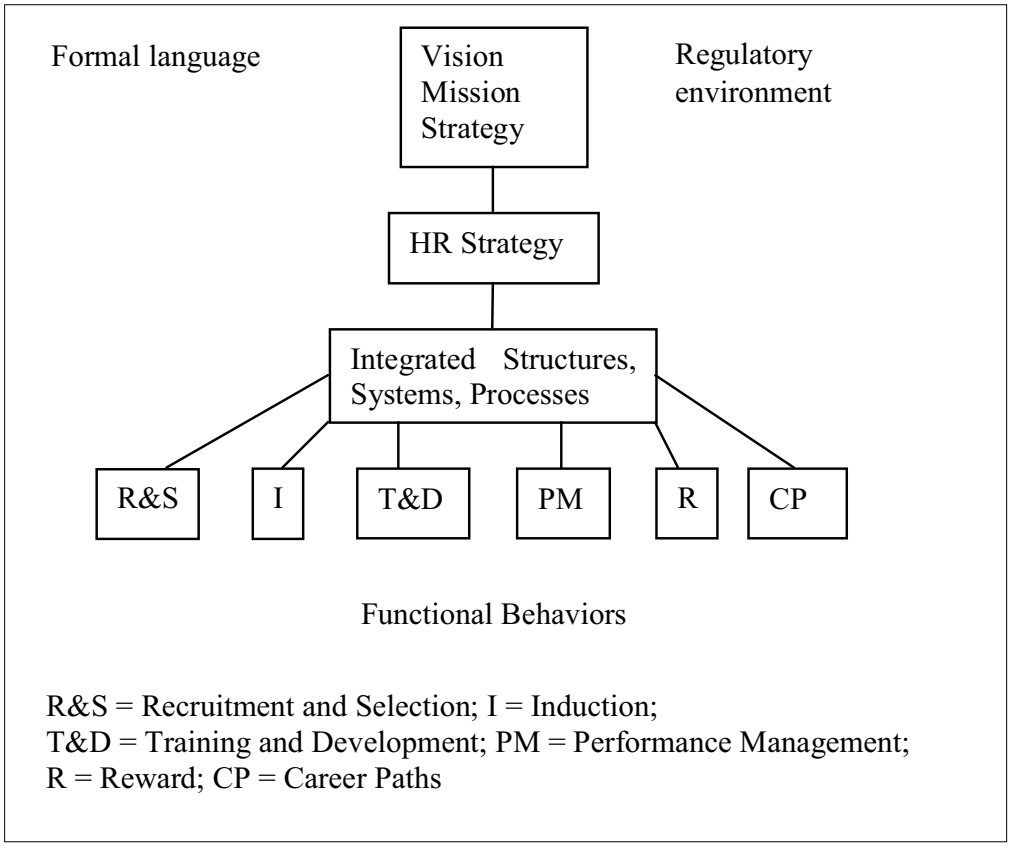


Figure 2: A complexity model for HRM

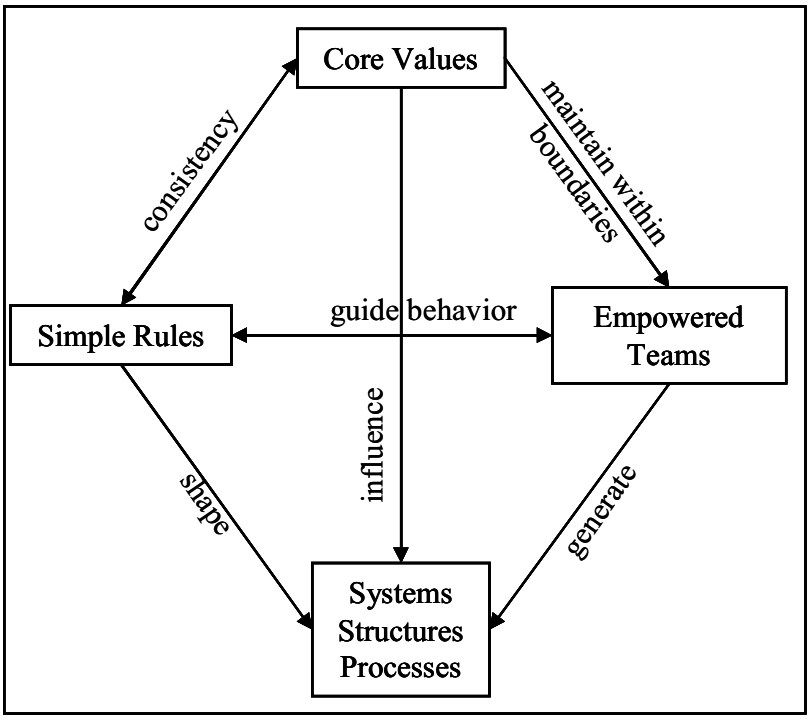
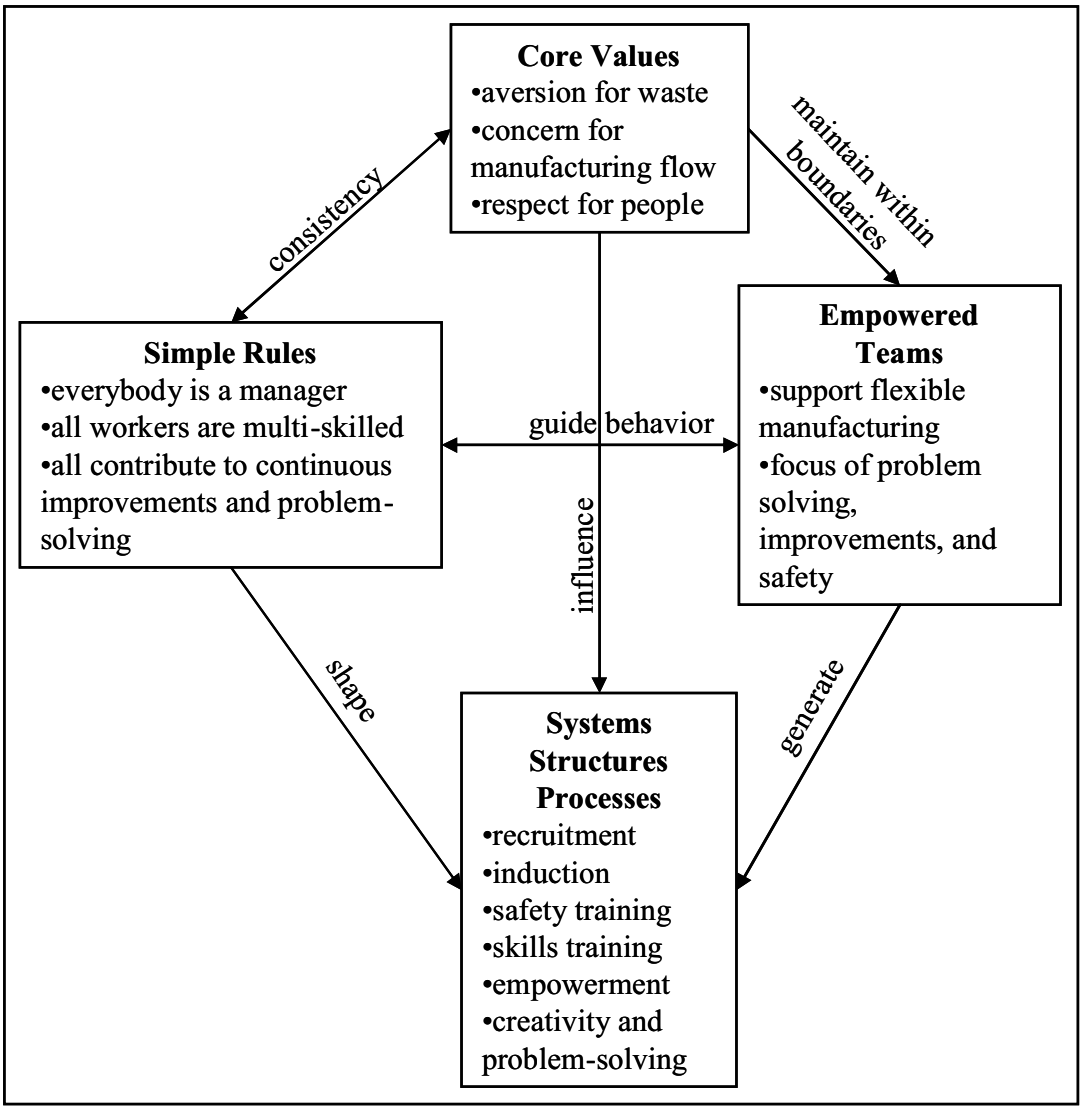


Figure 3: Complexity HRM model at Toyota



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